

**TECHNICAL MEMORANDUM  
COST COMPARISON FOR THE DISPOSAL OF VERMICULITE CONTAINING  
WASTE  
FROM THE LIBBY ASBESTOS SUPERFUND SITE OPERABLE UNIT 7  
DEQ Contract: 407026, Task Order 60**

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## **1.0 INTRODUCTION**

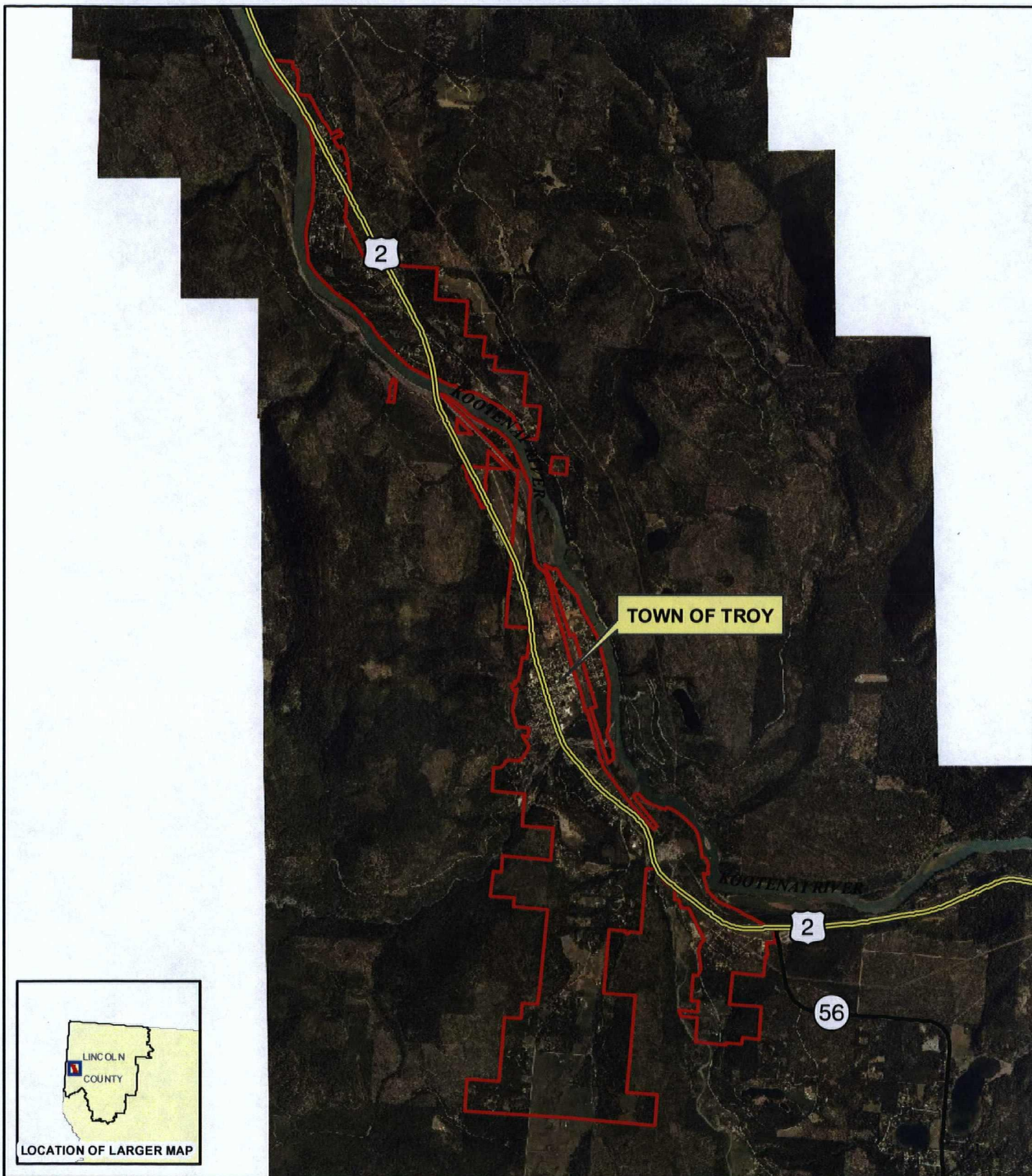
Task Order 60 was entered into between the Montana Department of Environmental Quality (DEQ) and Tetra Tech EM Inc. (Tetra Tech), pursuant to DEQ Contract No. 407026. The purpose of this Task Order is to prepare a technical memorandum comparing estimated transportation and disposal costs associated with three disposal options for Libby Asbestos (LA) - contaminated wastes to complete removal actions in Operable Unit 7 (OU7) of the Libby Asbestos Site (Figure 1). This Cost Comparison of Disposal Options for OU7 Technical Memorandum (Disposal TM) will be used by DEQ to determine the most cost-effective disposal method for the removal work in OU7 scheduled for 2010. This cost comparison evaluates only the costs associated with actual disposal of LA-contaminated waste and does not include costs associated with removal and loading of wastes from properties in OU7.

This Disposal TM identifies and documents estimated costs and supporting assumptions for three disposal options for the LA-contaminated wastes removed from OU7. The potential disposal options are: (A) transporting LA-contaminated soil and vermiculite containing insulation (VCI) for disposal at established locations near Libby (LA-contaminated soil would be disposed of at the Former Libby Vermiculite Mine [Mine] and VCI would be disposed of at the asbestos cell at the Lincoln County Landfill), (B) transporting LA-contaminated soil for disposal at a new landfill within OU7 and transporting VCI material for disposal at the Lincoln County Landfill, and (C) transporting all LA-contaminated material for disposal at a new landfill within OU7. Option A includes the costs of transporting LA-contaminated waste to the Libby area and paying established disposal costs. Option C includes the costs of transporting LA-contaminated waste to a yet-to-be determined landfill in OU7 and the locating, permitting, building, operating, and closing of this landfill. Option B includes elements of options A and C.

## **2.0 OPERABLE UNIT 7 WASTE DESCRIPTION AND CHARACTERIZATION**


In 1881, miners discovered vermiculite seven miles northeast of Libby, Montana. Mining began in the 1920s and continued until the mine closed in 1990. The vermiculite ore was mined and screened on-site, then shipped to various locations throughout the world.

The vermiculite ore body in Libby contains naturally occurring forms of asbestos. Asbestos is a generic term for a group of six, fibrous silicate minerals. The predominant mineral of concern at the Libby Asbestos Site is amphibole asbestos. Asbestos is a recognized human carcinogen and is classified as a hazardous substance as defined by 40 CFR Section 302.4 of the National Contingency Plan.



LOCATION OF LARGER MAP

## Legend

 OU 7 BOUNDARY



LIBBY ASBESTOS SUPERFUND SITE

**FIGURE 1**  
**OPERABLE UNIT 7**  
**VICINITY MAP**

The United States Environmental Protection Agency (EPA) placed the Libby Asbestos Site on the National Priorities List in October 2002. Currently the VCI from Libby is disposed of at the Lincoln County Landfill and the LA-contaminated soil is disposed of at the Mine.

The extent of vermiculite contamination in OU7 has been characterized by Tetra Tech. The main source areas, the mine and processing facilities, are located in and around Libby. Miners who worked in Libby and lived in Troy may have inadvertently brought home LA fibers on their bodies, clothing, and personal items. Troy residents have used the LA-contaminated vermiculite for insulation in homes or businesses and as soil supplements for yards and gardens. The characterization in OU7 is in its final stages and the disposal options for the LA-containing wastes are evaluated in this Disposal TM.

### 3.0 EXPLANATION OF DISPOSAL ALTERNATIVES

This section includes a brief evaluation of the costs for three alternatives for disposal of the vermiculite containing waste from OU7.

The following assumptions were used to prepare the costs:

- Vacuum boxes will be used for removing VCI from buildings in OU7
- Vacuum box capacity is 20 cubic yards
- VCI will be found in 107 buildings in OU7
- Buildings containing VCI in OU7 average 800 square feet of VCI
- The average depth of VCI is 10 inches
- The average distance from the VCI removal areas in OU7 to the Lincoln County Landfill is 23 miles
- The average distance from contaminated soil removal areas in OU7 to the Mine is 26 miles
- VCI disposal costs at the Lincoln County Landfill are \$1,800 per vacuum box
- Approximately 1,000,000 square feet of LA-contaminated soil is to be removed from OU7
- The average removal depth of the LA-contaminated soil is 12 inches
- Soil haul truck capacity is 14 cubic yards
- The OU7 portion of operating costs for contaminated soil disposal costs at the Mine is \$167,000 annually.
- An OU7 Landfill would operate under the same, or similar, plans and procedures as the Mine and the Lincoln County Landfill (e.g., misting tent and decontamination at the off-loading area, additional personnel to operate the off-loading area, etc.).
- MEANS Costworks Union labor is comparable to Davis Bacon wage rates.



- Heavy Construction prices for Kalispell, Montana are comparable to Heavy Construction prices in OU7.
- Mobilization and Insurance for Construction are 10% of construction costs.

Under Alternative A, the VCI waste would be transported to the asbestos unit at the Lincoln County Landfill that is currently being used to dispose of similar waste from Libby. The contaminated soil would be transported to the soil disposal area at the Mine.

Under Alternative B, a Resource Conservation and Recovery Act (RCRA) Subtitle D Class IV Landfill would be constructed within OU7 (OU7 Landfill). All LA-contaminated soil from OU7 would be disposed of at the OU7 landfill. VCI from OU7 would be transported to the Lincoln County Landfill for disposal in the asbestos cell.

Under Alternative C, all LA-contaminated waste (soil and VCI) from OU7 would be transported to the newly-constructed OU7 Landfill for final disposal.

Primary design parameters for the three alternatives are:

Alternative A: VCI disposal at Lincoln County Landfill and soil disposal at the Mine

- VCI waste volume: 2,642 cubic yards (CY)
  - 107 buildings, 800 square feet per building, 10 inches deep
- Contaminated soil volume: 37,037 CY
  - 1,000,000 square feet, 1 foot deep
- VCI waste average haul distance (round-trip): 46 miles
- Contaminated soil average haul distance (round-trip): 52 miles
- Contaminated soil transport truck cost: \$1,200 per day per truck
  - 14 CY capacity per truck
  - Fuel costs included
- Contaminated soil transport trucks make 2 disposal trips per day to the Mine
- Vacuum truck cost: \$550 per day
  - Used to transport VCI waste vacuum trailers
  - 20 CY capacity per trailer
  - one truck to pull all trailers to the disposal site
  - fuel costs included
- Four VCI removal crews – each crew can complete a house in 3 days
  - Use at least five vacuum trailers and one truck to pull the trailers to the disposal site
- OU7 portion of Former Libby Vermiculite Mine operating costs is \$167,000 annually

Alternative B: VCI disposal at the Lincoln County Landfill and soil disposal at the OU7 Landfill

- VCI waste volume: 2,642 CY
- Contaminated soil volume: 37,037 CY
- Contaminated soil density: 1.6 tons per CY
- VCI waste average haul distance (round-trip): 46 miles

- Contaminated soil average haul distance (round-trip): 6 miles
- Contaminated soil transport truck cost: \$1,200 per day per truck
- Contaminated soil transport trucks make 5 trips to the OU7 Landfill per day
- Vacuum truck cost: \$550 per day
- Four VCI crews – each crew can complete a house in 3 days
  - Use at least five vacuum trailers and one truck to pull the trailers to the disposal site
- OU7 Landfill operation costs: \$6,000 per month
  - Costs include one full-time employee operating construction equipment
- One domestic well installed up to 100 ft deep with a 5-horsepower pump
  - Decontamination water supply well
- OU7 Landfill Volume Capacity: 46,000 CY
  - Contaminated soil volume plus cover soil
  - 18 inch lifts of contaminated soil with 6 inches cover soil
- OU7 Landfill Area: 2.8 acres (square with 350 foot sides)
- OU7 Landfill Depth: 28 feet with 4:1 side slopes, no groundwater encountered
- Excavated soil will be stockpiled and used for daily and weekly cover
- Excess cover soil is sold or given away at negligible gain
- Top soil would be excavated and stockpiled on-site separately from cover soil
- No liner; base compacted to 95% proctor
  - No migration petition approval
- No groundwater monitoring
  - No migration petition approval
- OU7 Landfill Cap: 3 feet of on-site soil; 6 inches of topsoil
- Total revegetation area: 5.62 Acres
  - 2.8 acres plus soil stockpile area
- OU7 Landfill length of operation: 14 months (2 field seasons)

Alternative C: VCI and soil disposal at the OU7 Landfill

- VCI waste volume: 2,642 CY
- Contaminated soil volume: 37,037 CY
- Contaminated soil density: 1.6 tons per CY
- VCI waste average haul distance (round-trip): 6 miles
- Contaminated Soil average haul distance (round-trip): 6 miles
- Vacuum truck cost: \$550 per day
- 4 VCI crews – each crew can complete a house in 3 days
  - Use at least five vacuum trailers and one truck to pull the trailers to the disposal site
- Contaminated soil transport truck cost: \$1,200 per day per truck
- Contaminated soil transport trucks make 5 trips to the OU7 Landfill per day
- OU7 Landfill operation costs: \$18,000 per month
  - Costs equivalent to current operating costs at Lincoln County Landfill plus one full-time employee operating construction equipment
- One domestic well installed up to 100 ft deep with a 5-horsepower pump
- Misting Tent diameter: 40 feet
- Landfill Volume Capacity: 50,000 CY
  - Contaminated soil volume plus cover soil
  - 18 inch lifts of contaminated waste with six inches of cover soil
- Landfill Area: 2.8 acres (square with 350 foot sides)
- Depth of waste: 30 feet with 4:1 side slopes, no groundwater encountered
- Excavated soil will be stockpiled and used for daily and weekly cover
- Excess cover soil is sold or given away at negligible gain

- Top soil would be excavated and stockpiled separately
- No liner; base compacted to 95% proctor
- No groundwater monitoring
- Cap: 3 feet of on-site soil; 6 inches of topsoil
- Total revegetation area: 5.62 Acres
- OU7 Landfill length of operation: 14 months (2 field seasons)

The estimated cost of alternative A is shown in Table 1, the estimated cost of alternative B is shown in Table 2, and the estimated cost of alternative C is shown in Table 3. Unit costs used to estimate the cost of the three alternatives are based on existing costs at the Lincoln County Landfill, email messages between United States Army Corps of Engineers (USACE), EPA, and DEQ, current transportation costs, MEANS Costworks 2010, and the white paper developed by DEQ Solid Waste (DEQ 2009). The white paper is included in Appendix A.

**TABLE 1**  
**COST ESTIMATE - ALTERNATIVE A**  
**DISPOSAL AT ASBESTOS UNIT OF LINCOLN COUNTY LANDFILL AND FORMER LIBBY**  
**VERMICULITE MINE**

Cost Item	Quantity	Unit	Unit Cost (\$)	Cost (\$)
Capital Costs				
VCI Transportation	100	Days	\$550.00	\$55,000.00
VCI Disposal	100	Days	\$2,437.33	\$243,733.33
Soil Transportation	1,323	Days	\$1,200.00	\$1,587,600.00
Mine Operating Costs	2	Years	\$167,000.00	\$334,000.00
Subtotal Transport and Disposal Costs				\$2,220,333.33
Contingency	20% of Transportation and Disposal Costs			\$444,066.67
Total Capital Costs				\$2,664,400.00



**TABLE 2**  
**COST ESTIMATE – ALTERNATIVE B**  
**VCI DISPOSAL AT THE LINCOLN COUNTY LANDFILL AND SOIL DISPOSAL AT**  
**THE OU7 LANDFILL**

Cost Item	Quantity	Unit	Unit Cost (\$)	Cost (\$)
Capital Costs				
Class IV Landfill Application Review Fee	1	EA	\$3,600.00	\$3,600.00
Class IV Landfill Annual License Fee	2	EA	\$1,200.00	\$2,400.00
Bonding	1	LS	\$134,550.00	\$134,550.00
Tonnage Fees (\$0.40 per ton State Fee)	59,259	Tons	\$0.40	\$23,703.70
Mobilization and Insurance	1	LS	\$25,814.34	\$25,814.34
Excavation	46,000	CY	\$1.67	\$76,820.00
Stockpile	46,000	CY	\$2.30	\$105,800.00
Base Compaction	12,212	SY	\$1.48	\$18,073.43
Fencing	2,400	LF	\$20.50	\$49,200.00
Cap Cover Soil Application	10,000	SY	\$1.62	\$16,200.00
Cap Top Soil Application	10,000	SY	\$0.54	\$5,400.00
Groundwater Supply Well	100	LF	\$42.50	\$4,250.00
Pump	1	EA	\$4,000.00	\$4,000.00
Revegetation	5.62	AC	\$1,500.00	\$8,436.64
Closure Maintenance	2.81	AC	\$15,000.00	\$42,183.20
Subtotal Capital Costs				\$520,431.31
Operation and Transport Costs				
Landfill Operating Costs	14	Months	\$6,000.00	\$84,000.00
VCI Transportation	100	Days	\$2,987.33	\$298,733.33
Soil Transportation	530	Days	\$1,200.00	\$636,000.00
Subtotal Operation and Transport Costs				\$1,018,733.33
Contingencies		20% Construction, Operation and Transport Costs		\$307,832.93
Project Management		8% Construction Costs		\$41,634.51
Engineering Design		15% Construction Costs		\$78,064.70
Construction Management		10% Construction Costs		\$52,043.13
Total Capital Costs				\$2,018,739.91

Notes: AC = Acre      CY = Cubic Yard      LF = Lineal Feet  
LS = Lump Sum      SY = Square Yard      EA = Each

TABLE 3

**COST ESTIMATE – ALTERNATIVE C  
CONSTRUCTION OF A CLASS IV LANDFILL IN OU7 FOR SOIL AND VCI DISPOSAL**

Cost Item	Quantity	Unit	Unit Cost (\$)	Cost (\$)
<b>Capital Costs</b>				
Class IV Landfill Application Review Fee	1	LS	\$3,600.00	\$3,600.00
Class IV Landfill Annual License Fee	2	EA	\$1,200.00	\$2,400.00
Bonding	1	LS	\$250,870.00	\$250,870.00
Tormage Fees (\$0.40 per ton State Fee)	59,580	Tons	\$0.40	\$23,832.10
Mobilization & Insurance	1	LS	\$32,490.46	\$32,490.46
Excavation	50,000	CY	\$1.67	\$83,500.00
Stockpile	50,000	CY	\$2.30	\$115,000.00
Base Compaction	12,645	SY	\$1.48	\$18,714.60
Fencing	2,400	LF	\$20.50	\$49,200.00
Cap Cover Soil Application	13,611	SY	\$1.62	\$22,050.00
Cap Top Soil Application	13,611	SY	\$0.54	\$7,350.00
Revegetation	5.62	AC	\$1,500.00	\$8,430.00
Misting Tent	1,256	SF	\$40.00	\$50,240.00
Groundwater Supply Well	100	LF	\$42.50	\$4,250.00
Pump	1	EA	\$4,000.00	\$4,000.00
Closure Maintenance	2.81	AC	\$15,000.00	\$42,150.00
<b>Subtotal Capital Costs</b>				\$718,077.16
<b>Operation and Transport Costs</b>				
Landfill Operating Costs	14	Months	\$18,000.00	\$252,000.00
VCI Transportation	100	Days	\$550.00	\$55,000.00
Soil Transportation	530	Days	\$1,200.00	\$636,000.00
<b>Subtotal Operation and Transport Costs</b>				\$943,000.00
Contingencies	20% Construction, Operation and Transport Costs			\$332,215.43
Project Management			8% Construction Costs	\$57,446.17
Engineering Design			15% Construction Costs	\$107,711.57
Construction Management			10% Construction Costs	\$71,807.72
<b>Total Capital Costs</b>				\$2,230,258.06

Notes: AC = Acre      CY = Cubic Yard      LF = Lineal Feet  
 LS = Lump Sum      SY = Square Yard      EA = Each

#### 4.0 COMPARISON OF DISPOSAL ALTERNATIVES

All three alternatives involve disposal of the materials at a RCRA licensed facility or at the Mine, which is operated by EPA. Therefore all three alternatives are equally protective of the environment. For Alternatives B and C, the bonding costs would be recouped after a 30 year closure period if no major reclamation activities are necessary to repair the landfill during that time, so actual costs may be less than shown.

The alternatives ranked by cost from least expensive to most expensive are:

1. Alternative B - \$2,018,740
2. Alternative C - \$2,230,258
3. Alternative A - \$2,664,400

The cost of each alternative is highly dependent upon the estimated number of trips per day for contaminated soil transport and disposal. The contaminated soil constitutes 93% of the total LA-contaminated waste volume that must be disposed of either at the Mine or a newly constructed OU7 Landfill. Decreasing the distance increases the number of loads per day the trucks can haul, which would reduce the daily transportation cost. The Alternative A cost estimate assumes 2 trips per day from OU7 to the Mine. Alternative B assumes 5 trips per day to a newly constructed OU7 Landfill. Based on the trip per day estimate for Alternative B, the capital cost of building an OU7 Landfill is more than covered by savings due to the increased trips per day.

Under Alternative B, the VCI is disposed of at the Lincoln County Landfill and the soil is disposed of at a newly constructed OU7 Landfill. It is less costly to dispose of the VCI from OU7 at the Lincoln County Landfill under this alternative than at the newly constructed OU7 Landfill because; (1) the capital cost of installing a misting tent system and excavating and preparing the extra volume in the landfill necessary to dispose of the VCI is not offset by the lower transportation costs, and (2) the cost of VCI removal is dependent on how quickly a crew cleans a house (average 3 days per residence), not on the proximity to the disposal facility (number of trips per day).

#### 5.0 SUMMARY

Based on the comparative analysis of the three disposal alternatives for LA-contaminated waste and soil from OU7, Alternative B is the most cost effective. Under this alternative the VCI waste is disposed of at the Lincoln County Landfill and the soil is disposed of at a newly constructed Class IV Landfill in OU7.

## REFERENCES

*Average Landfill Construction Cost Minimums Per Acre.* Montana Department of Environmental Quality. 2009.

*RE: Tech Memo for disposal options for OU7.* Email from John Hartley of USACE to Catherine LeCours of DEQ. January 6, 2010.

*RE: General questions about removal activities.* Email from Mike Cirian of EPA to Catherine LeCours of DEQ. November 30, 2009.

**APPENDIX A**  
**AVERAGE LANDFILL CONSTRUCTION COST MINIMUMS**  
**PER ACRE**

## AVERAGE LANDFILL CONSTRUCTION COST MINIMUMS PER ACRE

The liner components required during Class II or IV landfill construction vary considerably depending largely on subgrade properties and soils available on site. Usually both a leachate collection blanket (LOB) and leachate removal system (LRS) are needed as noted below, but other liner minimums are also provided for LRS only options (sites where monitoring waived).

### AVERAGE LANDFILL CONSTRUCTION COSTS:

Starting from scratch for each category of liner type, the current average MINIMUM landfill construction costs can be broken down as follows:

Excavation (natural barrier)	\$100,000 per acre (range \$100,00 – 250,000 per acre for soil vs bedrock subgrade)
Composite liner & leachate system	\$525,000 per acre (range \$300,000 – 750,000 per acre for soil vs bedrock subgrade, LCB & LRS)
Natural clay-HDPE liner & leachate system	\$200,000 per acre (soil subgrade acts as barrier component, LCB & LRS)
Compacted clay layer (CCL) only	\$150,000 per acre (2-ft thick, soil subgrade provides borrow, LRS)
Prescriptive composite cap	\$80,000 per acre (gas layer, 18-in CCL, HDPE, drainage layer, protective layer, topsoil)
Alternative final cover (AFC)	\$40,000 per acre (3.0-ft thick monolithic soil AFC, topsoil, no capillary break)
Active methane gas control system	\$50,000 per acre (methane collection wells, pipe system, flare, controls)
Minimum post closure maintenance	\$15,000 per acre (30 yrs for cap plus leachate, no ponds or monitoring)

### TOTAL AVG CONSTRUCTION & POST-CLOSURE REPAIR COSTS:

The capacity of storm water and leachate UST or ponds, and the number and depth of methane and ground water monitoring wells, varies considerably based on site conditions. Those highly variable costs must be added to the average construction and repair estimates below. The costs given are MINIMUM estimates based on utilization of a 3-ft soil final cover (AFC).

Composite lined landfill (AFC)	\$580,000 – 635,000 per acre (depends on methane control system or not)
Alternative lined landfill (AFC)	\$205,000 – 255,000 per acre (no methane control)
No-migration landfill (AFC)	\$155,000 – 175,000 per acre (no methane control)

*Note: The actual site-specific post-closure repair costs could vary considerably from the average per acre minimum provided due to on-site active gas control, monitoring, or corrective action!*